We Claim

1) An apparatus for the production and purification of a ^{213}Bi radioisotope from an ^{225}Ac radioisotope source comprising:

a. a compatible solvent,

b. a primary column having an inlet, an outlet, and a primary sorbent which preferentially retains ^{225}Ac over ^{213}Bi when exposed to said compatible solvent,

c. a secondary column having an inlet and an outlet, said inlet in communication with the outlet of said primary column, said secondary column further having a secondary sorbent which retains ^{213}Bi when exposed to a mixture of said compatible solvent and ^{213}Bi.

2) The apparatus of claim 1 further comprising an eluent reservoir containing a eluent, said eluent capable of removing said ^{213}Bi from said secondary sorbent, and said eluent reservoir in communication with said secondary column.

3) The apparatus of claim 1 further comprising at least one pump in communication with said primary column and configured to pump said compatible solvent through said primary and secondary columns.

4) The apparatus of claim 3 further comprising:

a compatible solvent reservoir,

a first valve, and

a controller,

said first valve disposed to control the flow of said compatible solvent to said primary column,

said controller in communication with said pump and said first valve and configured to operate said pump and said first valve such that said first valve

is opened and said compatible solvent is pumped through said primary and secondary columns at predetermined intervals to retain said ^{213}Bi on said secondary sorbent.

5) The apparatus of claim 4 further comprising a second valve, said second valve disposed to control the flow of said eluent through said secondary column.

6) The apparatus of claim 5 further comprising a second outlet on said secondary column, thereby allowing said eluent to be flowed through said secondary column in the opposite direction said compatible solvent is flowed through said secondary column.

7) The apparatus of claim 6 further comprising a third valve, wherein third valve is configured to allow said pump to alternate between

a. flowing said compatible solvent through said primary and secondary columns, and

b. flowing said eluent through said secondary column.

8) The apparatus of claim 7 wherein said controller is further configured to control said first valve, said second valve, said third valve, and said pump, so that, alternately

a. said compatible solvent is pumped through said primary and secondary columns at predetermined intervals to retain said ^{213}Bi on said secondary sorbent, and

b. said eluent is pumped through said secondary column, providing said ^{213}Bi at said second outlet of said secondary column.

9) The apparatus of claim 1, wherein said primary sorbent is a resin bonded to a support selected from the group of polymeric supports, silica supports, inorganic particulate supports, or combinations thereof.

10) The apparatus of claim 1, wherein said primary sorbent is selected from the group of:

a. inorganic matrices impregnated with sulfonic, phosphoric, or phosphonic acid extractants, and combinations thereof, and

b. polymeric matrices impregnated with sulfonic, phosphoric, or phosphonic acid extractants, and combinations thereof.

11) The apparatus of claim 9 wherein said primary sorbent is selected as a resin grafted on a support selected from the group: polymeric supports, silica supports, inorganic particulate supports, and combinations thereof.

12) The apparatus of claim 11, wherein said resin is selected from the group of chelating resins, cation exchange resins, and combinations thereof.

13) The apparatus of claim 12, wherein said chelating resin is selected from the group of materials having a diphosphonic acid functionality and materials having a organophoshoric acid functionality grafted on said support.

14) The apparatus of claim 12, wherein said cation exchange resin is selected from the group of: materials having a sulfonic acid functionality grafted on said support and materials having carboxylic acid functionalities grafted on said support.

15) The apparatus of claim 1, wherein said secondary sorbent is an anion exchange resin grafted on a support selected from the group of polymeric supports, silica supports, inorganic supports, and combinations thereof.

16) The apparatus of claim 15, wherein said anion exchange resin is selected as a long chain ammonium salt.

17) The apparatus of claim 16, wherein said long chain ammonium salt is selected from the group of quaternary ammonium salt, tertiary ammonium salt, and combinations thereof.

18) The apparatus of claim 1 wherein said compatible solvent is selected as an HCl solution.

19) The apparatus of claim 18 wherein said HCl solution is about 1.0 M.

20) The apparatus of claim 18 wherein said HCl solution is between about 0.1 and 0.2M.

21) The apparatus of claim 5 wherein said eluent is a sodium acetate solution between about 0.1 and 0.5 M with a pH of about 5.

22) The apparatus of claim 5 wherein said eluent is an acetic acid solution of about 0.5 M.

23) The apparatus of claim 1 wherein one or more additional primary columns are interfaced with said secondary column.

24) The apparatus of claim 23 wherein said primary columns are in series.

25) The apparatus of claim 23 wherein said primary columns are in parallel.

26) A method for the production and purification of a ^{213}Bi radioisotope from an ^{225}Ac radioisotope source comprising the steps of:

a. providing a primary column having an inlet, an outlet, and a primary sorbent which preferentially retains ^{225}Ac over ^{213}Bi when exposed to a compatible solvent,

b. providing a secondary column having an inlet and an outlet, said inlet in communication with the outlet of said primary column, said secondary column further having a secondary sorbent which retains ^{213}Bi when exposed to a mixture of said compatible solvent and ^{213}Bi.

c. loading ^{225}Ac onto the primary sorbent,

d. flowing said compatible solvent through the primary column and into the secondary column, thereby transferring ^{213}Bi formed as a radioactive

decay product of said ^{225}Ac in the primary column to the secondary column,

e. retaining said ^{213}Bi on the secondary sorbent, and

f. flowing an eluent through the secondary column, thereby removing the ^{213}Bi from the secondary column.

27) The method of claim 26 wherein said primary sorbent is selected from the group of:

a. inorganic matrices impregnated with sulfonic, phosphoric, or phosphonic acid extractants, and combinations thereof, and

b. polymeric matrices impregnated with sulfonic, phosphoric, or phosphonic acid extractants, and combinations thereof.

28) The method of claim 26 wherein said primary sorbent is selected as a resin grafted on a support selected from the group: polymeric supports, silica supports, inorganic particulate supports, and combinations thereof.

29) The method of claim 28, wherein said resin is selected from the group of chelating resins, cation exchange resins, and combinations thereof.

30) The method of claim 29, wherein said chelating resin is selected from the group of materials having a diphosphonic acid functionality and materials having a organophoshoric acid functionality grafted on said support.

31) The method of claim 29, wherein said cation exchange resin is selected from the group of: materials having a sulfonic acid functionality grafted on said support and materials having carboxylic acid functionalities grafted on said support.

32) The method of claim 26, wherein said secondary sorbent is an anion exchange resin grafted on a support selected from the group of polymeric supports, silica supports, inorganic supports, and combinations thereof.

33) The method of claim 32, wherein said anion exchange resin is selected as a long chain ammonium salt.

34) The method of claim 33, wherein said long chain ammonium salt is selected from the group of quaternary ammonium salt, tertiary ammonium salt, and combinations thereof.

35) The method of claim 26 wherein said compatible solvent is selected as an HCl solution.

36) The method of claim 35 wherein said HCl solution is about 1.0 M.

37) The method of claim 35 wherein said HCl solution is between about 0.1 and 0.2M.

38) The method of claim 26 wherein said eluent is a sodium acetate solution between about 0.1 and 0.5 M with a pH of about 5.0.

39) The method of claim 26 wherein said eluent is a acetic acid solution of about 5.0 M.